Insights and experience on analyses of proposed Federal climate bills in the USA

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World Bank

Expert Meeting: Modeling For Carbon Pricing Instruments

EPA Climate Analyses

111th Congress

- American Power Act (**Kerry – Lieberman**)
  - June 14, 2010
- American Clean Energy and Security Act of 2009 (H.R. 2454) (**Waxman – Markey** House Passed)
  - January 29, 2010
- The Clean Energy Jobs and American Power Act of 2009 (**Kerry - Boxer**)
  - October 23, 2009
- American Clean Energy and Security Act of 2009 (H.R. 2454) (**Waxman – Markey** Committee Passed)
  - June 23, 2009
- American Clean Energy and Security Act of 2009 (**Waxman – Markey** Discussion Draft)
  - April 20, 2009

110th Congress

- Lieberman-Warner Climate Security Act of 2008 (S. 2191) (**Lieberman – Warner**)
  - March 14, 2008
- Low Carbon Economy Act of 2007 (S. 1766) (**Bingaman – Specter**)
  - January 15, 2008
- Climate Stewardship and Innovation Act of 2007 (S. 280) (**Lieberman – McCain**)
  - July 16, 2007

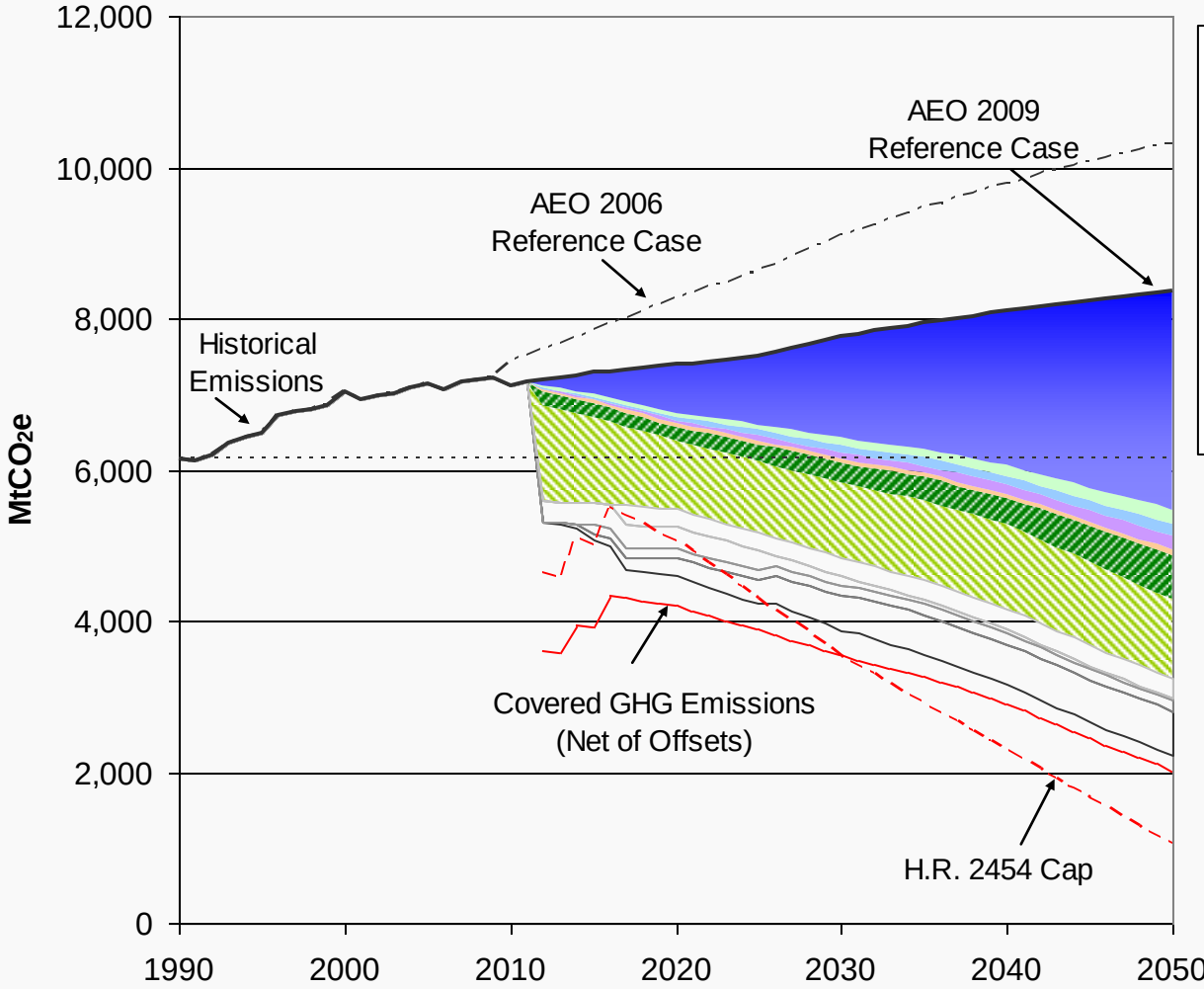
Types of Questions

- Where will emissions reductions come from?
- What roll can offsets play?
- What will the allowance price be?
- How much will it cost?
- How much revenue will be generated?
- What are the major uncertainties?
- What will it achieve?

Where will emissions reductions come from?

Total US GHG Emissions & Sources of Abatement

EPA's Supplemental H.R. 2454 Analysis (ADAGE)

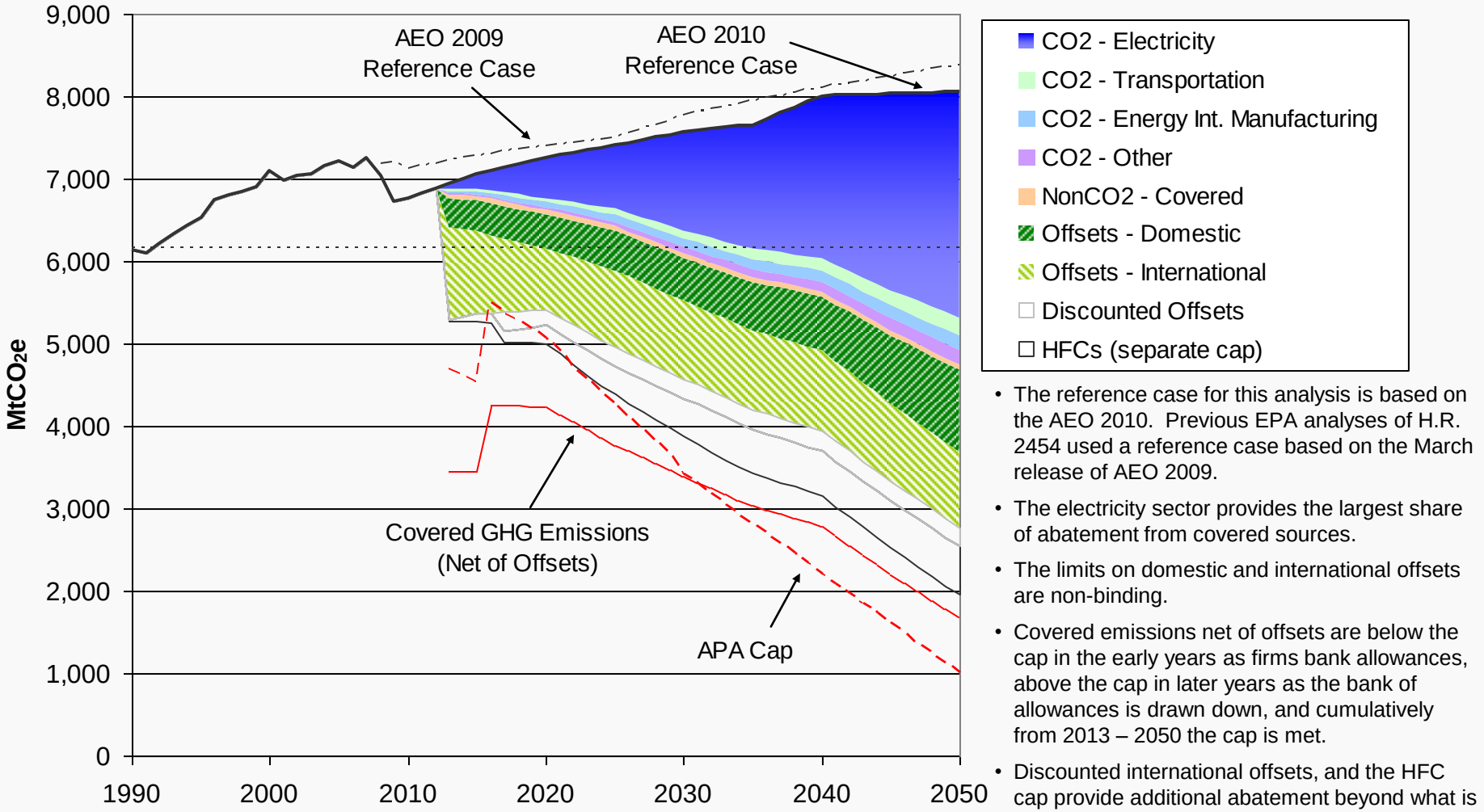


- Cumulative 2012-2050 GHG emissions are 14% (51 bmt) lower in the AEO 09 baseline compared to the AEO 06 baseline in ADAGE
- This is largely due to:
  - The inclusion of EISA;
  - Lower initial 2010 GDP ($13.2 trillion in AEO 09 vs $14.6 trillion in AEO 06);
  - And a lower projected GDP growth rate (2.5% in AEO 09 vs 3.0% in AEO 06).

Where will emissions reductions come from?

Total US GHG Emissions & Sources of Abatement

EPA's American Power Act Analysis (ADAGE)

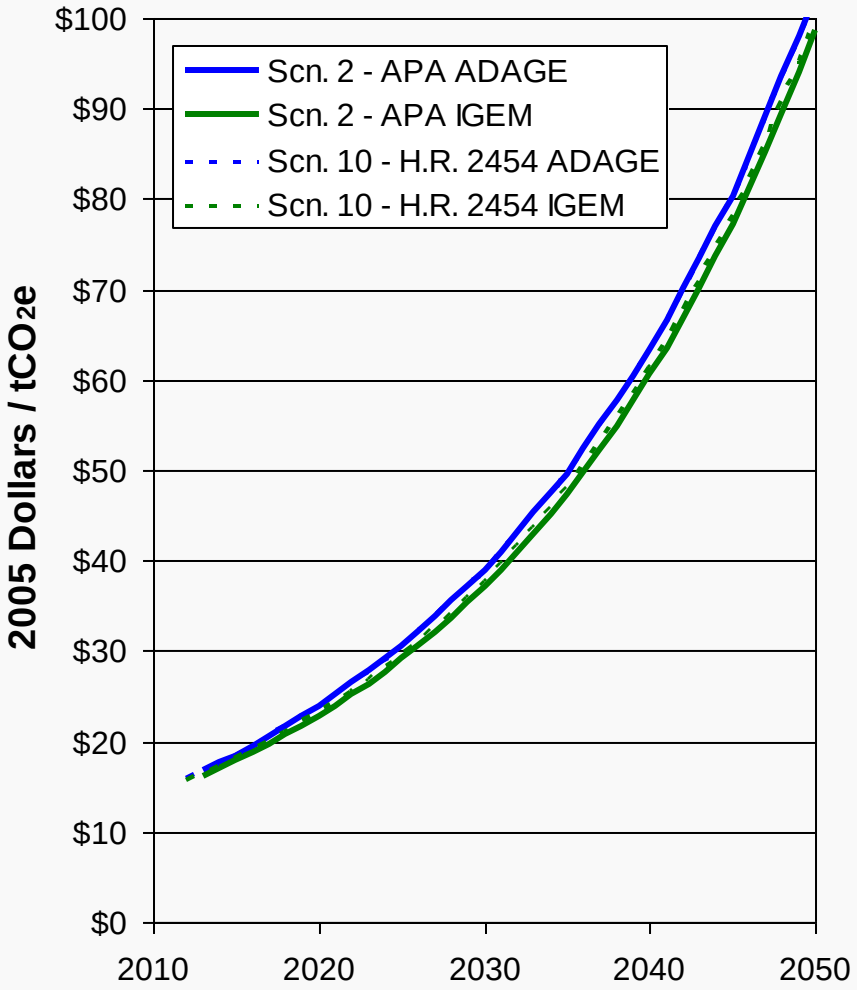


- The reference case for this analysis is based on the AEO 2010. Previous EPA analyses of H.R. 2454 used a reference case based on the March release of AEO 2009.
- The electricity sector provides the largest share of abatement from covered sources.
- The limits on domestic and international offsets are non-binding.
- Covered emissions net of offsets are below the cap in the early years as firms bank allowances, above the cap in later years as the bank of allowances is drawn down, and cumulatively from 2013 – 2050 the cap is met.
- Discounted international offsets, and the HFC cap provide additional abatement beyond what is required by the main cap.

What will the allowance price be?

GHG Allowance Prices

Scenario 2 – APA & Scenario 10 - H.R. 2454



	Scn. 2 - APA			
	2013	**2020**	**2030**	**2050**
ADAGE	$17	$24	$39	$102
IGEM	$16	$23	$37	$99

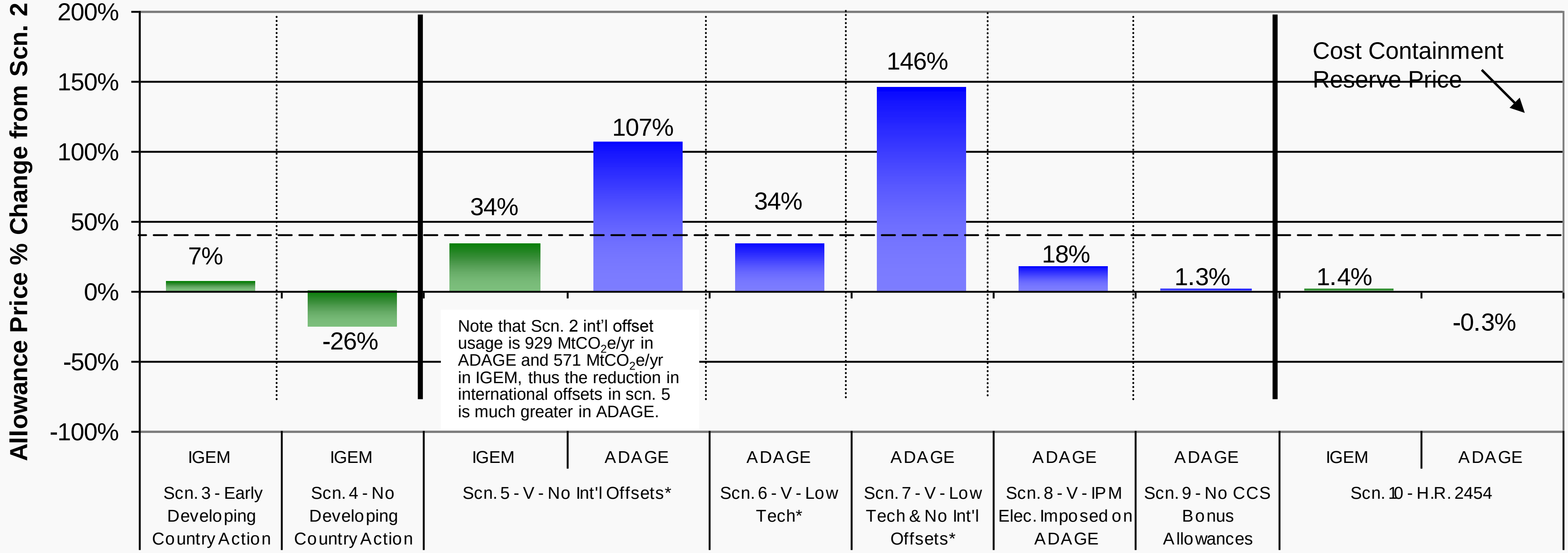
	Scn. 10 - H.R. 2454			
	2013	**2020**	**2030**	**2050**
ADAGE	$17	$24	$39	$102
IGEM	$16	$23	$38	$100

- The marginal cost of GHG abatement is equal to the allowance price.
- Range of 2030 allowance price in *"scenario 2 – APA"* across models is $37 - $39. This range only reflects differences in the models and does not reflect other scenarios or additional uncertainties discussed elsewhere.
- The limit on international offsets usage is non-binding in both models, and thus the domestic allowance price is equal to the international offset price (after discounting) and the international offset price acts as a floor on the allowance price.
- When the international offsets limit is non-binding, the differences in allowance prices between the models arises from differing demands for international offsets.
- Allowance prices under the American Power Act in scenario 2 are almost identical to allowance prices estimated for H.R. 2454 in scenario 10.

What are the major sources of Uncertainty? What will the allowance price be?

GHG Allowance Prices & Sensitivities

APA Scenario Comparison
Percentage Change from Scenario 2



Allowance Price % Change from Scn. 2
200%
150%
100%
50%
0%
-50%
-100%
7%
-26%
34%
107%
34%
146%
18%
1.3%
1.4%
-0.3%
Cost Containment Reserve Price
Note that Scn. 2 int'l offset usage is 929 $MtCO_2e$/yr in ADAGE and 571 $MtCO_2e$/yr in IGEM, thus the reduction in international offsets in scn. 5 is much greater in ADAGE.
IGEM
IGEM
IGEM
ADAGE
ADAGE
ADAGE
ADAGE
ADAGE
IGEM
ADAGE
Scn. 3 - Early Developing Country Action
Scn. 4 - No Developing Country Action
Scn. 5 - V - No Int'l Offsets*
Scn. 6 - V - Low Tech*
Scn. 7 - V - Low Tech & No Int'l Offsets*
Scn. 8 - V - IPM Elec. Imposed on ADAGE
Scn. 9 - No CCS Bonus Allowances
Scn. 10 - H.R. 2454

Note: percentage changes apply in all years.

- In scenario 2 the limit on international offsets usage is non-binding, and thus the impact of these sensitivities on allowance prices is muted by the change in the usage of international offsets (e.g. a change that would ordinarily lead to lower allowance prices instead would lead to fewer international offsets.)
- ADAGE shows greater usage of international offsets than IGEM in scenario 2, so removing international offsets in scenario 5 has a much larger impact on allowance prices in ADAGE than in IGEM.

* Scenarios 5 – 7, place limits on technology and international offsets.

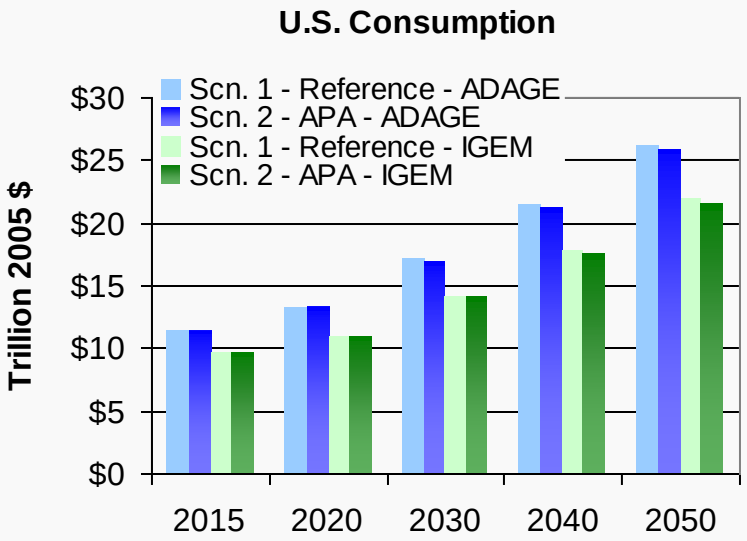
- In ADAGE scenarios 5 and 7, the reserve price is reached, and all 4 billion tons of reserve allowances are sold. This reduces the impact on allowance prices in these scenarios. Since international offsets are not allowed, it is not possible to use the revenues from auctioning reserve allowances to purchase REDD offsets to refill the reserve. Thus the allowance price is able to exceed the reserve (ceiling) price.

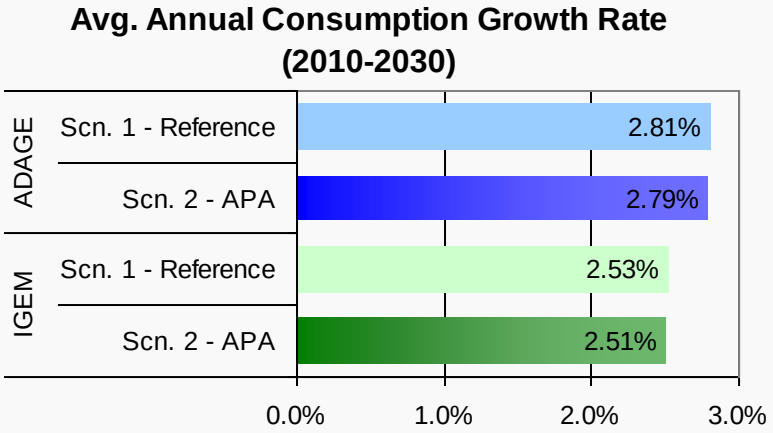
*Scenario 5 ADAGE results updated 6/30/10

How much will it cost?

Consumption (APA Analysis)

Scenario 1 – Reference & Scenario 2 - APA





ADAGE	2015	2020	2030	2040	2050
% Change	-0.14%	-0.17%	-0.46%	-0.68%	-0.86%
Annual Change / HH	-$122	-$169	-$529	-$901	-$1,316
NPV of Change / HH	-$91	-$99	-$190	-$199	-$178

Average Annual Cost per Household (NPV)	**-$146**
Total Cost per Household (2010-2050) (NPV)	-$5,985

IGEM	2015	2020	2030	2040	2050
% Change	0.00%	0.01%	-0.16%	-0.72%	-1.10%
Annual Change / HH	-$3	$12	-$153	-$786	-$1,360
PV of Change / HH	-$2	$7	-$55	-$173	-$184

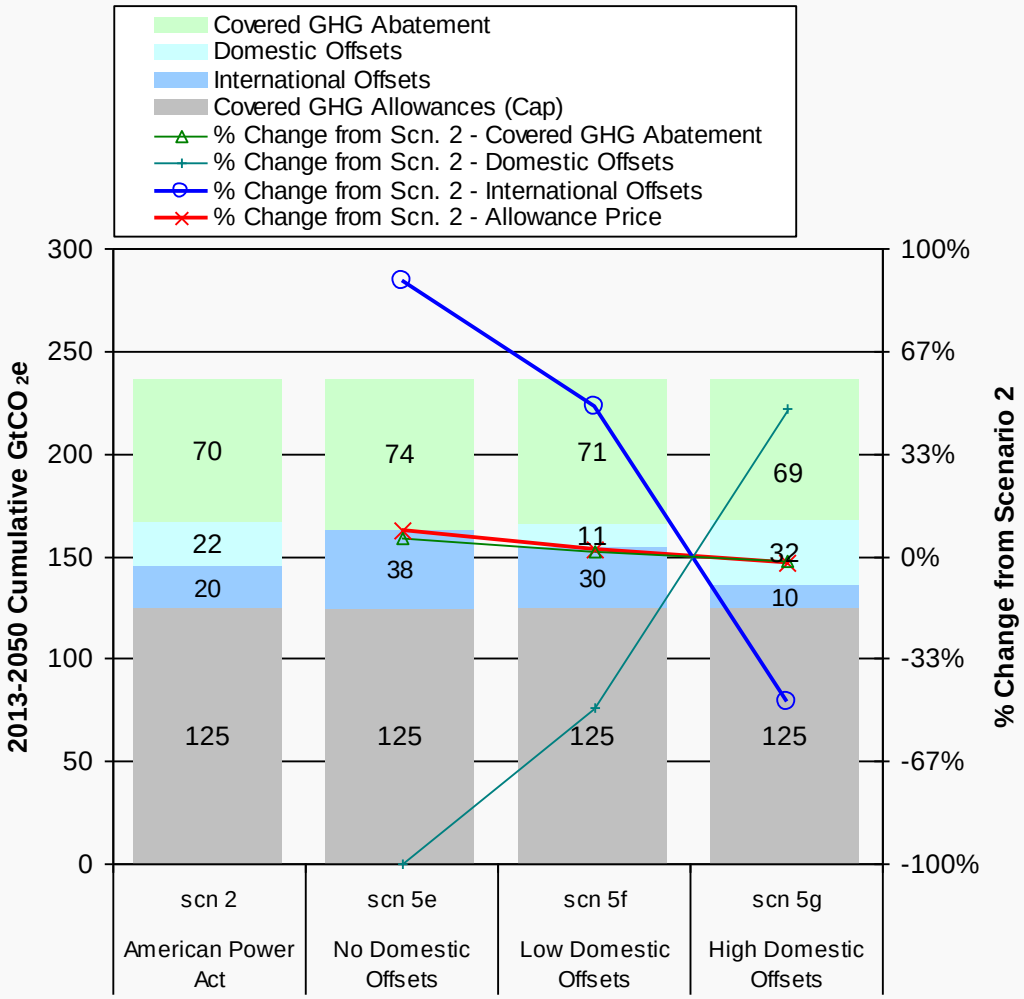
Average Annual Cost per Household (NPV)	**-$79**
Total Cost per Household (2010-2050) (NPV)	-$3,225

- The average annual cost of the APA per household is the 2010 through 2050 average of the net present value of the per household consumption loss in "*scenario 2 – APA*."
  - The net present value of the per household consumption loss is the cost in a particular year discounted back to today.
- The costs above include the effects of higher energy prices, price changes for other goods and services, impacts on wages and returns to capital, and importantly, the value of emissions allowances returned lump sum to households, which offsets much of the APA's effect on household consumption. The cost does not include the impacts on leisure.
- This analysis is a cost-effectiveness analysis, not a cost-benefit analysis. As such, the benefits of reducing GHG emissions were not determined in this analysis.

What roll will offsets play?

2013-2050 Cumulative Covered U.S. GHG (APA Analysis) Emissions & Abatement

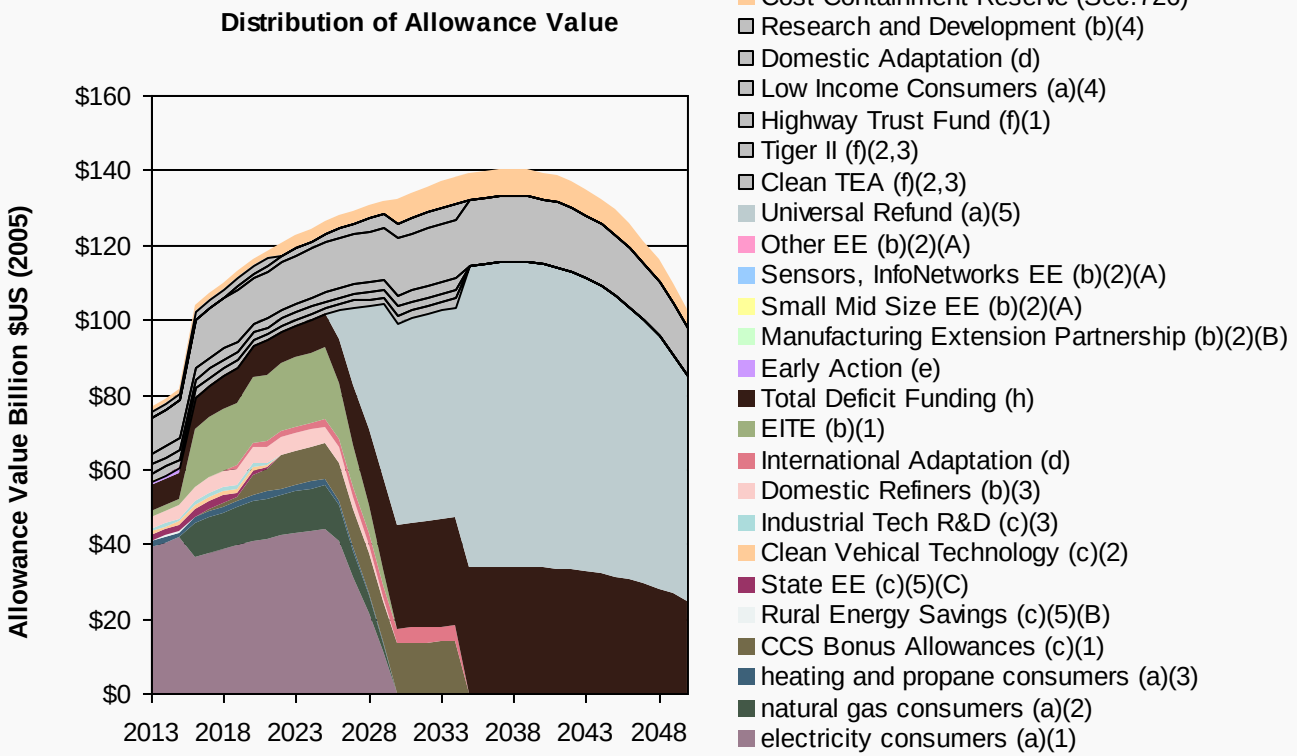
Domestic Offset Sensitivities(IGEM)



- Since the annual limit on the usage of international offsets is non-binding in scenario 2, sensitivities that would be expected to impact allowance prices (e.g. changes in the availability of domestic offsets) have a smaller impact than expected, because international offsets usage, and thus the amount of abatement within covered sectors, can change.
- When domestic offsets are not allowed, international offset usage increases 89% up to the adjusted limit, covered GHG abatement increases 6%, and the allowance price increases 8%
- If domestic offset potential is reduced 50%, then international offset usage increases 49%, covered GHG abatement increases 1%, and allowance prices increase 2%.
- If domestic offset potential is increased by 50%, then international offset usage falls by 48%, covered GHG abatement decreases 1%, and allowance prices decreases 2%.
- Scenarios 5e and 5f would show considerably different results in they were run using the ADAGE model, as scenario 2 in ADAGE uses close to the maximum amount of international offsets allowed, so reducing domestic offset availability would force greater amounts of covered GHG abatement, and have a larger impact on allowance prices.

How much revenue will be generated?

Value of Allocated & Auctioned Allowances (APA Analysis) (IGEM/ADAGE)



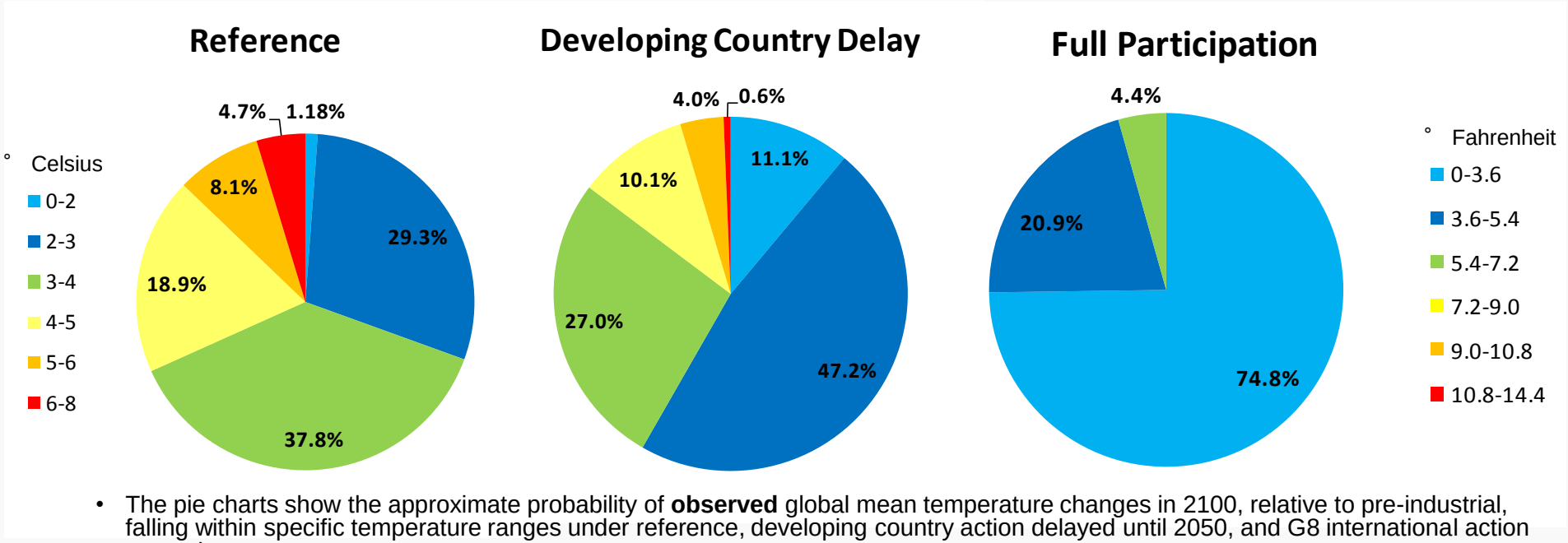
- The allowance prices used in this figure are from the IGEM "*scenario 2 APA*". The sets of components explicitly modeled by ADAGE and IGEM are slightly different from each other – details can be found in appendix 1.
- Both of the computable general equilibrium models used in this analysis have a single representative agent household. Any auction revenue returned to households clearly accrue to households. Additionally, any private sector revenues from allocated allowances also accrue to the employee-shareholder households.
- While being able to provide outcomes on aggregate household impacts, the limitation of a single representative household model is its inability to show household distributional results of the various policy scenarios. Distributional results of a separately conducted analysis are discussed at the end of this report.

- If auction revenues that are modeled as being returned to households lump sum were instead directed to particular funds, the expected reduction in household annual consumption and GDP would likely be greater. However, such revenues could be used to lower existing distortionary taxes and thus reduce policy costs. See "Scenario 16 – Revenue Recycling – Labor Tax" of EPA's January 29, 2010 supplemental analysis of H.R. 2454 for analysis of this issue.

What will it achieve?

Probability of Observed Temperature Changes in 2100

Reference, Delayed Participation, and Full Participation Scenarios



- The pie charts show the approximate probability of **observed** global mean temperature changes in 2100, relative to pre-industrial, falling within specific temperature ranges under reference, developing country action delayed until 2050, and G8 international action scenarios.
- Observed temperature change does not equal the change in equilibrium temperature because
  - **CO_2e concentrations rise after 2100**: Equilibrium temperature change is not achieved until after CO_2e concentrations are stabilized. In this analysis, CO_2e concentrations will continue to rise after 2100. Therefore, changes in equilibrium temperature will differ from the observed temperature changes.
  - **Ocean temperature inertia**: This inertia causes the equilibrium global mean surface temperature change to lag behind the observed global mean surface temperature change by as much as 500 years. Even if CO_2e concentrations in 2100 were stabilized, observed temperatures would continue to rise for centuries before the equilibrium was reached.
- Under the Reference scenario (1st chart), the probability of the observed temperature change in 2100 being below 2 degrees C is approximately 1%, while there is a nearly 75% probability associated with this under the Full Participation scenario (3rd chart).
- The probability of being above 4 degrees C is about 32% in the Reference case, while it is just under 15% in the Delayed Participation scenario (2nd chart) and zero under Full Participation (3rd chart).